WILDLIFE DISEASES AND PARASITES IN THE KITIKMEOT REGION, 1984-90

Northwest Territories Renewable Resources

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WILDLIFE DISEASES AND PARASITES IN THE KITIKMEOT REGION, 1984-90

ANNE GUNN

TED LEIGHTON

AND

GARY WOBESER

DEPARTMENT OF RENEWABLE RESOURCES

GOVERNMENT OF THE NORTHWEST TERRITORIES

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ABSTRACT

Our report compiles information on wildlife health in the Kitikmeot Region (1984-90) based on 117 diagnoses determined for samples provided by hunters. We also report the results of systematic surveys of certain parasites in muskoxen (Ovibos moschatus) and caribou (Rangifer tarandus). Most (48%) of the diagnoses were for brucellosis in caribou. Our interviews of hunters in Pelly Bay, Spence Bay and Gjoa Haven on their traditional knowledge of brucellosis describe the high incidence of brucellosis in caribou of the eastern Kitikmeot as a recent phenomenon. The prevalence of parasites in caribou and muskoxen monitored during annual caribou and muskox collections reveal relatively low parasite burdens. Parasitic infections with clinically manifested signs were uncommon for Dictyocaulis sp. lungworm and Besnoitia sp. in both caribou and muskoxen. The exception was a prevalence of 90% for an as yet undescribed protostrogylid lungworm in the muskox population west of Coppermine.

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INTRODUCTION

Wildlife management studies in the Northwest Territories have largely ignored the frequency, distribution and causes of parasitism and disease. With few exceptions, reports of diseases and parasites are limited to opportunistic observations and are scattered in unpublished reports and government files. In the 1980s, several factors started to change the attention paid to the health of wildlife.

Many ungulate populations, especially barren-ground caribou (Rangifer tarandus groenlandicus) and muskoxen (Ovibos moschatus), have increased markedly in the 1980s (Case et al. 1989, Williams and Heard 1986). Those increases are leading to opportunities for more harvesting especially commercial harvesting (Gunn et al. In press). Increases in the development of country food marketing have given impetus to the need to monitor wildlife health. The only mandated inspection is by Agriculture Canada for meat exported across territorial or provincial boundaries. To date, this has only applied to commercial muskox harvests on Banks Island but standards are being developed for within the NWT.

Concerns over the unregulated transport of live wildlife between provinces and territories have drawn attention to the lack of knowledge of endemic diseases and parasites. For example, in the NWT, the proposed sale of reindeer to Alberta and B.C. raised questions about the prevalence of besnoitosis and brucellosis.

Another factor in raising the interest in wildlife diseases

in the Kitikmeot Region which was delimited from the Fort Smith Region only in 1982 was the hiring of a regional biologist in 1983. The biologist improved the hunters' access to information on wildlife diseases by facilitating the diagnosis of samples at the Western College of Veterinary Medicine (WCVM) and ensuring that the diagnoses reached the hunters. As hunters receive replies to their queries about the health of the wildlife, their readiness to provide samples has been encouraged. In addition, as hunters are acute observers and their observations are passed among themselves, they have long term knowledge on the prevalence of diseases with characteristic clinical signs. A significant factor in providing information to hunters has been the ready access to the diagnostic services of WCVM and the availability of pathologists for field support.

Reliance on the samples provided by hunters has the advantage of widespread sampling for any clinical signs of diseases or parasites. More quantitative information and detection of sub-clinical signs are obtained through the systematic sampling and screening for evidence of exposure to certain diseases either on an opportunistic basis or for a specific disease or parasite.

Our report compiles information on wildlife health from three sources in the Kitikmeot Region (1984-90). We report the diagnoses determined for samples provided by hunters and the surveys of traditional knowledge of brucellosis in Pelly Bay, Spence Bay and Gjoa Haven. There is a relatively high incidence of brucellosis in caribou of the eastern Kitikmeot and the clinical signs are well

known to the hunters. The third source of information on wildlife health is the results of the caribou and muskox collections whose primary or secondary objectives were to investigate the prevalence of diseases and parasites.

METHODS

1. Samples provided by hunters

Renewable Resource Officers (RROs) maintain a record of comments or complaints from the public (Occurrence Reports) which include wildlife diseases. When possible, hunters were asked to bring any samples of unusual or diseased caribou to the Officer who forwards the sample to the Regional Biologist. Most samples were then sent to WCVM, unless the cause was obvious without further examination and bacteriological testing.

Opportunistic examinations of wildlife found dead during surveys and unusual incidents are also reported. The unusual incidents include the collection of 27 muskoxen on August 24-25, 1984. The muskoxen were shot on a small island in Surrey Lake, southeastern Victoria Island as they had been trapped on the island since spring break-up and had consumed or trampled most of the island vegetation. The muskox carcasses were examined by a veterinary pathologist and then butchered and the meat sent to eastern Kitikmeot communities.

A second unusual incident was the marooning of several hundred caribou on Rideout Island (Bathurst Inlet) in September 1987. During the investigation, carcasses were examined and 5 caribou collected.

2. Survey of traditional knowledge on brucellosis

In Pelly Bay and Spence Bay, Joe Ashevak (RRO) chose the

hunters and conducted the interviews in Inuktitut. In Gjoa Haven, Luke Cody (RRO) designed a questionnaire (Table 1) for a local person to use to interview the elders of the community without the distractions of simultaneous translations and to enable the elder to relax and tell his/her knowledge of the subject. The person selected to do the survey was Thomas Anguttitauruq who has been used as a court interpreter and is himself an active hunter.

3. Collections to monitor prevalence of specific diseases and parasites

Caribou, southeast Victoria Island 1987-90

Caribou were collected in April to obtain samples for a taxonomic study and to monitor condition, parasites and health. Serum samples were taken and tested by Agriculture Canada for brucellosis antibodies. Autopsies were performed on the animals, and any gross pathological signs were recorded; livers were sliced and examined for cysticerci; leg fascia were checked for roughness indicative of besnoitosis (in April 1990, pieces of skin from the phalangeal area were histologically examined for Besnoitia cysts); bronchioles were opened to check for lungworms and the lungs were felt for any nodules or firm areas; the pharyngeal cavities were opened to verify the presence or absence of nosebots (Cephenemyia sp.) and warble larvae (Oedemagena sp.) were counted on the hides.

Muskoxen, southeast Victoria Island 1988-90

Muskoxen were collected in April (1989, 1990), May (1989, 1990), July (1990), August (1989), September (1990) and November

Table 1. Questionnaire for traditional knowledge of brucellosis in Gjoa Haven, 1990.

The Department of Renewable Resources is trying to find out more information on the traditional knowledge of brucellosis. Was this disease around in the old days or is it something that is recent? Brucellosis is a disease that affects caribou by swelling of the joints and/or testes, abscesses or yellow fluid in the meat and, as a result of swollen joints, abnormal hoof growth.

1. Did you ever see a caribou with brucellosis ?

2. Was it long ago or recently ?

3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ?

4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ?

5. When was the first time you might have seen something in a caribou similar to brucellosis ?

(1989, 1990) to obtain samples for a study of condition and reproduction and to monitor parasites and health. Serum samples were tested by Agriculture Canada for brucellosis antibodies. Autopsies were performed on the animals in the field, and any gross pathological signs were recorded; livers were sliced and examined for cysticerci; bronchioles were opened to check for lungworms and the lungs were felt for any nodules or firm areas; and the warble larvae were counted on the hides. The pyloric end of the abomasum was opened and scraped clean to allow subjective ranking of the Ostertagia pitting and haemorrhaging as minimal, mild or moderate. In April 1990, skin samples from phalangeal areas were histologically examined for Besnoitia.

Protostrongylid lungworm, Coppermine, 1989-90

Hunters with muskox tags for Management Unit C1-2 were requested to provide the lungs, pieces of skin from the phalangeal area and mandibles (April 1990). As the lung samples were frequently incomplete sets, they were weighed in the Renewable Resources lab, partially thawed and sliced at approximately 1 cm intervals so protostrongylid nodules could be counted. The mandibles were cleaned and tooth eruption patterns described. The leg skin samples were histologically examined for Besnoitia cysts at WCVM.

RESULTS

1. Samples provided by hunters

Between 1983 and 1986, reports on wildlife diseases and parasites and samples were relatively scanty. One sample was diagnosed in 1984, 10 in 1985 and 6 in 1986. Reporting efforts increased in 1987 and we compiled the details obtained from hunters on wildlife diseases in 126 Occurrence Reports (Table 2) between July 1987 and June 1990. The Occurrence Reports are maintained using the tag issue year which runs from 1 July to 30 June each year. We have included in Table 2, 19 diagnosed samples received between January and June 1987. In the three subsequent reporting years (1987-88, 1988-89, 1989-90), 65 % of the Occurrence Reports on diseases were also accompanied by a tissue sample and resulted in 69 pathological diagnoses as 13 samples were lost or were too decomposed for diagnosis. In addition, 23 samples were received directly in the lab from hunters who had not reported the incident to an RRO (Table 2).

In total, 117 cases were diagnosed through the services of WCVM between 1984 and 1990 (Table 3). In 8 cases (classified as Miscellaneous in Table 3), there was no diagnosis or the diagnosis was starvation but a cause for the starvation was not evident.

The highest proportion of diagnoses (48%) is for brucellosis (Table 4) followed by Miscellaneous (35%). Cases classified as miscellaneous (Table 3) included abscesses (6), rehealed fractures or amputations (7), besnoitosis (8), tumour (2), arthritis or joint infections (5), congenital deformities (1), emphysema (1),

Table 2. Summary of Renewable Resources Officer reports from hunters on wildlife diseases (without samples) and samples received directly in the Renewable Resources lab, Kitikmeot region, 1987-90.

Settlement/ Year	Caribou Sample	Caribou Report	Canine Sample	Canine Report	Other Sample	Other Report
Spence Bay (includes Pelly Bay)						
1987-88	16	8	2	4	1	0
1988-89	13	4	0	0	0	0
1989-90	17	3	0	0	2	0
Coppermine (includes Holman)						
1987-88	1	1	1	2	0	0
1988-89	5	4	2	0	2	1
1989-90	2	2	1	0	0	2
Cambridge Bay						
1987-88	0	1	4	0	0	2
1988-89	2	0	2	0	1	2
1989-90	2	5	3	0	0	0
Gjoa Haven						
1987-88	3	1	0	0	0	0
1988-89	0	4	0	0	0	1
1989-90	0	2	0	0	0	1
Samples received in lab (no Occurrence Report)						
1987-88	1	0	6	0	3	0
1988-89	0	0	2	0	1	0
1989-90	10	0	0	0	0	0

Table 3. Summary of pathological diagnoses made by WCVM on samples received from the Kitikmeot Region, 1984-90.

Station/species	Brucell-osis	Tapeworm cysts	Canine Distemper	Misc.
Spence Bay				
Caribou	46	2	0	12
Dog	0	0	3	0
Fox	0	0	0	2
Polar bear	0	0	0	2
Cambridge Bay				
Caribou	0	2	0	8
Dog	0	0	1	0
Fox	0	0	0	1
Polar bear	0	0	0	1
Muskoxen	0	0	0	4
Coppermine				
Caribou	5	3	0	9
Dog	0	0	3	0
Fox	0	0	2	0
Muskoxen	1	0	0	1
Polar bear	0	0	0	1
Gjoa Haven				
Caribou	6	2	0	5

Table 4. Summary of pathological diagnoses for caribou with confirmed brucellosis infection, Kitikmeot region, 1987 - 90.

	Carpal Bursitis	Chronic Arthritis	Subcutaneous Abscess	Muscular Abscesses	Orchitis
1990	1	0	0	0	1
1989	7	3	1	0	4
1988	3	5	2	0	5
1987	8	1	5	5	4
1986	1	0	0	0	1
1985	0	1	0	0	0

glomerulitis (1), eye infection (1), omasal impaction (1), skin traumatic lesions (1) and dermoid cyst (1). Rehealed fractures, amputations and infections were, in some cases, the result of bullet wounds.

Officers received 16 reports of canids with behaviour suggestive of rabies between 1987 and 1990. The 12 samples (domestic dogs - 7, foxes - 4, wolf - 1) sent to the Agriculture Canada lab resulted in 10 positive cases (2 dogs were negative). The number of cases reported through Occurrence Reports for the Kitikmeot Region is an under-estimate because some cases are handled by the RCMP. Agriculture Canada's summary of rabies (Table 5) records 8 positive and 16 negative tests compared to the Renewable Resources listing of 6 positive and 2 negative tests for the same time period (September 1987 to March 1989) in the Kitikmeot Region.

When the positive cases of rabies are totalled for winters (August to July), winter 1987/88 had 7 cases compared to 4 in 1986/87 and 3 in 1985/86. Between September 1988 and March 1989, no positive cases were diagnosed (Table 5). The peak in the number of canids with rabies coincided with an epidemic in canine distemper (Appendix B).

We received 14 samples of dogs and 8 arctic fox samples (Appendix B), but autolysis of tissues was a problem as the insulative value of the fur retarded carcass freezing especially for the fox samples. Six of the foxes were a sub-sample of 100 foxes gathered and necropsied from among the some 700 foxes shot in

Cambridge Bay in October 1987, but were too autolysed for diagnosis. The foxes had invaded Cambridge Bay starting in September in unprecedented numbers and were summarily dispatched as a public nuisance. Only two were reported with behaviour suggestive of rabies and both tested negative (Table 5). One fox from the outpost camp at Contwoyto Lake (February 1988) had interstitial pneumonia which is strongly suggestive of distemper (CDV), but the immunoperoxidase test was equivocal. A fox found dead in Coppermine in March 1988 had pulmonary congestion but tests for CDV were negative. The samples of dogs resulted in 7 diagnoses for CDV and 2 suspected CDV diagnoses, 2 diagnoses of Parvovirus (PV) and 1 for combined PV and CDV. One dog had multifocal lymphoid lesions consistent with either CDV or PV and two samples were too autolysed for diagnosis. The disease was rapid and acute as the only reported sign was death in 12 cases in some instances preceded by depression and lack of appetite - one dog had diarrhoea and one dog was shot as "sick".

One female polar bear in good condition from near Holman had patches of hairless skin which was otherwise normal. The cause was unknown. The organs of two bears that had been killed as nuisance bears were examined. The bear shot in Spence Bay in March 1988 had an open wound on its paw which might have been an inconvenience, but no microscopic lesions were found to explain the bear's poor condition. A female polar bear shot at an outpost camp near Holman in April 1988 had glomerulitis which might have resulted in the

Table 5. Results of Agriculture Canada's testing of suspected rabid animals in the Kitikmeot region, July 1985 - March 1989.

Date	Location	Species	Result	
			Negative	Positive
July 22/85	Holman Island	red fox		Pos
October 25/86	Cambridge Bay	arctic fox		Pos
November 06/85	Cambridge Bay	arctic fox		Pos
December 17/85	Cambridge Bay	cat	Neg	
February 01/86	Jenny Lind Island	arctic fox	Neg	
April 22/86	Holman Island	arctic fox		Pos
October 30/86	Cambridge Bay	arctic fox		Pos
October 30/86	Cambridge Bay	arctic fox		Pos
February 17/87	Gjoa Haven	dog	Neg	
	Gjoa Haven	dog		Pos
May 27/87	Cambridge Bay	arctic fox		Pos
September 01/87	Cambridge Bay	arctic fox	Neg	
October 02/87	Cambridge Bay	dog	Neg	
October 14/87	Cambridge Bay	arctic fox	Neg	
October 30/87	Cambridge Bay	dog	Neg	
November 16/87	Spence Bay	arctic fox		Pos
November 18/87	Cambridge Bay	dog	Neg	
December 01/87	Spence Bay	arctic fox		Pos
December 11/87	Holman	dog	Neg	
December 22/87	Pelly Bay	arctic fox		Pos
December 24/87	Holman	dog	Neg	
February 12/88	Bathurst Inlet	arctic fox		Pos
February 13/88	Coppermine	dog	Neg	
February 18/88	Pelly Bay	arctic fox		Pos
February 28/88	Spence Bay	polar bear	Neg	
March 23/88	Cambridge Bay	dog		Pos
March 24/88	Pelly Bay	arctic fox		Pos
	Bay Chimo	arctic fox	Neg	
September 20/88	Coppermine	arctic fox	Neg	
	Coppermine	arctic fox	Neg	
October 25/88	Gjoa Haven	dog	Neg	
November 29/88	Coppermine	dog	Neg	
February 20/89	Holman	dog	Neg	
	Holman	red fox		Pos
March 08/89	Cambridge Bay	cat	Neg	

bear's poor condition. A large male bear taken near the Astronomical Islands by a hunter from Pelly Bay had a subcutaneous cyst on its chest possibly a healing traumatic injury. A yearling bear was found dead in Hadley Bay in April 1989 and had starved to death possibly as a result of being separated from its mother.

Two of the eight muskox cases (Table 3) were particularly interesting. An adult bull with necrotizing solar laminitis and necrosis of the scrotal skin is the first recorded infection of muskoxen with Besnoitia. Another bull with unilateral orchitis also taken by a hunter in 1988-89 from the Coppermine area was the second isolate of Brucella suis Type 4 in muskoxen.

One bull harvested near Holman and two bulls from near Cambridge Bay had clinical signs consistent with traumatic injuries of which two were healing penetrative skin wounds in male muskoxen that had been harvested. The third case was an adult bull muskox found dead and which had a penetrative wound to the eye and subsequent infection that extended along the optic nerve and involved the meninges and possibly part of the brain. A newborn calf found dead, was too autolysed for diagnosis. Two of the eight cases were muskoxen found dead near Cambridge Bay: a cow was found dead from gastroenteritis in August 1988 and a bull dead from omasal impaction in November 1985 (E. Broughton pers. comm.). The impaction possibly resulted from the ingestion of forage at a time when water or snow was unavailable as a hard quick freeze-up occurred in the absence of any snowfall. An adult muskox bull found dead on central Victoria Island in August 1990 had a ruptured

duodenum with extensive severe subcutaneous haemorrhaging along the flank. We surmised that the rupture was caused by horn impact during rut fighting.

Among the 27 muskoxen shot on Surrey Lake in August 1984, there were 4 calves (2 females, 2 males), 9 yearlings (6 females, 3 males), and 14 adults (10 females, 4 males). No significant pathological conditions were described (Appendix C) and none of the carcasses were condemned.

The nine caribou examined on Rideout Island had no signs of pathological conditions except serous atrophy. The incident is being reported in detail (Heard et al. In Prep.) and the effect of the marooned caribou on the vegetation of the island is also described elsewhere (Henry and Gunn 1991).

2. Survey of traditional knowledge on brucellosis

In Pelly Bay, 10 hunters were interviewed 13 May, 1990 and 10 hunters were interviewed in Spence Bay, 18 January, 1990 (Table 6, Appendix A). In Gjoa Haven, Thomas Anguttitauruq went to each elder's home (May 1990) and interviewed them using the prepared questions (Table 1). One difficulty that was encountered was trying to interview certain elders who had severely impaired hearing. Other elders wanted to be paid for their stories (a result of a past study which paid elders for their stories of traditional life). Despite these minor problems fourteen people were interviewed (Table 7, Appendix A).

There was overwhelming support among the hunters interviewed

Table 6. Summary of interviews for traditional knowledge of brucellosis in caribou from hunters in Pelly Bay, Spence bay and Gjoa Haven, 1990.

Community/ Answers	Was brucellosis seen long ago?	Is brucellosis a recent problem?
Pelly Bay		
Answer "no"	10	0
Answer "yes"	"occasionally"	11
Spence Bay		
Answer "no"	9	0
Answer "yes"	1	10
Gjoa Haven		
Answer "no"	12	0
Answer "yes"	"possibly"	14

Table 7. Summary of responses to questions on traditional knowledge of brucellosis in Gjoa Haven, 1990.

Responses	"Ever see brucellosis?"	"Long ago or recent?"	"Known in old days"	"Recent problem"	"First time seen?"
"Yes"	14	13	0	12	-
"No"	0	0	12	0	-
"Long time ago"	0	0	1	1	1
"Unknown"	0	0	1	0	1
"Mostly"	0	1	0	1	0
"1980s"	-	-	-	-	12

in the three eastern Kitikmeot communities for the recent appearance of brucellosis in caribou. In each of the three communities, however, one hunter recollected from elders that brucellosis may have been present long ago.

3. Collections to monitor prevalence of specific diseases

Caribou and muskox collections

On southeastern Victoria Island 62 caribou and 120 muskox serum samples collected between 1986 and 1990 were found to be negative for brucellosis. The single Pelly Bay collection of 23 caribou was taken between 23 and 25 April, 1987. Six of the 17 caribou serum samples tested positive for brucellosis. Only one caribou had a morphological lesion associated with Brucella suis type 4 and that was an inflammatory change in the epididymis of a male. Four other animals had kidney or liver lesions and two of those were serum positive, one was negative and serum was not collected from one.

No serious pathological conditions were found during gross necropsies of 62 caribou on southeast Victoria Island, 1986 - 90 and parasite loads were not substantial (Table 8). One cow had a recently fractured rib, pneumonic patches and extreme emaciation and a second cow had a polycystic kidney - a developmental anomaly. Among the 152 muskoxen harvested on southeast Victoria Island in 1989 and 1990, one cow in April 1989 had severe chronic pyometra. One cow had unilateral hydronephrosis and a second cow in the May 1989 collection had chronic, multifocal cholangiohepatitis of

Table 8. Results of field examination of caribou cows for Besnoitosis, cystocercus and warbles on southeast Victoria Island, April 1987-90.

Date	No. Adults	No. infected		Warbles (range) Mean +/- S.D.
		Besnoitosis	Cystocercus	
1987	19	1	0	11 (2 - 46) 10.0 ± 14.23
1988	24	0	0	9 (2 - 73) 4.3 ± 10.26
1989	19	5	2	18 (2 - 125) 39.7 ± 36.6
1990	20	0	4	20 4 - 215 72.9 ± 53.99

unknown cause.

The prevalence of Dictyocaulus sp. lungworms in the muskoxen on southeast Victoria Island was 11.8% and the level of infestation was also low at a mean of 11.8 ± 12.5 (S.D.) worms counted in both lungs (Table 9). All muskoxen aged 12 months and older had at least some Ostertagia. In 1989, 6 calves in August and 2 of 4 calves in November were infected to the minimal level rating. In 1990, however, all 8 calves in July were rated zero, 4 of 7 calves in September were rated zero and 1 of 3 calves in November were also rated zero. The numbers of warble flies were low and the flies were about half the size of the larvae seen in caribou at the same time of year suggesting that possibly muskoxen are not a suitable host.

Dental anomalies and pathology of the muskox and caribou mandibles will be reported elsewhere. The only mandibular lesions

Table 9. Prevalence of lungworm, Ostertagia and warbles in muskoxen collected on southeast Victoria Island, 1989-90.

Date	Collected	Lungworm	Osteragia	Warbles
Apr/89	20	0	20	2
May/89	13	6	13	0
Aug/89	16	0	16	0
Nov/89	9	0	8	0
Apr/90	14	0	14	1
May/90	22	6	14	-
Jul/90	17	3	9	-
Sep/90	19	3	15	-
Nov/90	22	0	21	-

were from three muskoxen from Victoria Island with swellings along the mandibular shaft ventral to the molariform teeth. The pathology of those swellings is as yet unknown.

4. Collections to determine prevalence of specific parasites

Protostrongylid lungworm, Coppermine, 1989-90

The first finding of protostrongylid lungworm was in a radio-collared cow found dead on 6 June 1988, 2 days after drug immobilization. Her lungs had at least 30 lungworm nodules and probable pneumonia -- the actual cause of death was likely rumen impaction. The deaths of two more radio-collared cows and subsequent autopsies suggested that perhaps the finding of the lungworm was not an isolated incident. Cow 140 had been killed by

a grizzly bear, and had numerous (50+) nodules in her lungs. Cow 140 was found dead on 12 August 1989 and Cow 160 died in October 1989. Pneumonia was the suspected cause of death for cow 160 and she had 50 protostrongylid nodules.

Finding high numbers of a previously undescribed lungworm in the three cows prompted us to examine a larger sample of lungs to describe the prevalence and individual infection levels. We purchased 53 lungs from hunters in November 1989, April 1990 and November 1990 (Table 10) and found that 92.5% of the lungs had macroscopic protostrongylid lungworm nodules. The April harvest is non-resident hunting for large bulls which had greater accumulations of nodules. The November harvests concentrate on sub-adults and cows and further analysis will be carried out on the effect of sex/age class on the number of nodules when the ages of the muskox teeth have been established.

The number of nodules reported is an under-estimate as not all hunters took complete lungs - in November 1989, 4 of 17 lungs were complete and 1 of 8 in April 1990. When the survey was continued in November 1990, 17 of 28 lungs were complete.

The muskox host has a strong local reaction to the lungworm and forms a nodule of a thick layer of fibrous connective tissue surrounding a mass of coiled adult worms and amorphous debris. The adult worms were surrounded with masses of larval worms many of which appeared dead and necrotic. The nodules are formed next to bronchioles which the larvae can successfully enter as they were also identified within the bronchiole. The lungworms appear to

Table 10. Numbers of protostrongylid lungworm nodules detected macroscopically in muskox lungs, Coppermine, 1989 - 90.

Date	Number lungs	lungworm nodules		
		mean	S.D.	Range
Nov/89	17	29.9	33.3	0 - 92
Apr/90	8	106.0	90.8	0 - 258
Nov/90	28	31.5	22.5	2 - 84

cause only local inflammation and the greatest effect on the lung is through displacement and compression of the surrounding lung tissue.

One yearling muskox taken in November 1989 had 16 protostrongylid nodules, but the lung also had irregular areas of firmness and pallor that were diagnosed as verminous pneumonia. Nematodes were not recovered from those lesions, but the location and size of the lesions were highly suggestive of Dictyocaulus sp. infection. The lesions and amount of lung damage were more severe than that caused by the nodular lungworm although at the gross level the changes are less dramatic. Four other muskoxen had a few individuals of Dictyocaulus visible in the bronchioles.

Besnoitia

Besnoitia cysts were histologically found in 4 of 18 skin samples from hunter-killed muskoxen from 1989 - 90 near Coppermine and in 1 of 2 samples of muskoxen found dead (wolf kill and a bull with a broken leg after breaking through the ice). An additional two bulls were shot one during hunting (November 1988) and one because he was lame (November 1990). Both bulls had clinical signs associated with large numbers of Besnoitia cysts (solar laminitis).

Clinical signs of besnoitosis in caribou were less dramatic than those seen in the two muskox bulls and were ulcerative dermatitis restricted to the legs. Two cases were seen from the mainland south of Gjoa Haven, two from Victoria Island and one from Coppermine. Roughness of leg fascia from Besnoitia cysts was evident in 6 of 82 caribou collected on Victoria Island 1986-90 and 3 of 6 radio-collared caribou collected in May 1989.

DISCUSSION

The number of samples received and diagnosed is low compared to the annual harvest of wildlife in the Kitikmeot Region. Only 95 samples of caribou were diagnosed which compares with the annual harvest of 6,000. Hunter selection and tendency to report diseases or take samples bias any extrapolation of the number of samples to even a crude index of prevalence. Hunters vary as to whether they select for or against an obviously diseased animal. Most hunters avoid any conspicuously lame or emaciated animal but occasionally a hunter will comment that he deliberately shot a crippled or distressed animal. The proximity to the community and weather are among the factors that influence a hunter to retrieve or abandon a diseased carcass, report it or bring the diseased portion to the Renewable Resource Officer.

Hunters' reports and samples tend to be restricted to conspicuous signs of disease, but many diseases and parasites while inconspicuous may have significant effects at the population level. Nevertheless, the value of the information provided through the hunters is instrumental in revealing the presence of diseases. Since 1985, in the Kitikmeot Region, samples from hunters have revealed brucellosis in caribou and only the second recorded case in muskoxen as well as clinical signs of Besnoitosis in muskoxen (first recorded cases) and in caribou (previously only a few records). Other unusual findings were Linognathus setosus lice on

an arctic fox and larval cysts of Taenia serialis in the muscle - usually the larval cysts are found rodent or lagomorph muscles (Dieterich 1981). The fox likely acquired the infection from wolf faeces.

The most prevalent disease in caribou was brucellosis. The high proportion of serum positive caribou and the high numbers of caribou with clinical signs suggest a high prevalence of brucellosis in caribou in the vicinity of Pelly Bay, Spence Bay and Gjoa Haven. Before the 1980s, only scattered and infrequent cases of brucellosis in caribou were recorded across the NWT. In the early 1980s, about 30 % of caribou tested on Baffin Island were serum positive for brucellosis which coincided with increases in the numbers of caribou (M. Ferguson pers. comm. 1990). Also in the early 1980s, hunters from the eastern Kitikmeot communities started to see more caribou (Gunn and Ashevak 1990) and caribou with signs of brucellosis. Possibly, brucellosis in caribou in the NWT cycles with the number of caribou as has been described for caribou and reindeer in Alaska (R. Dieterich pers. comm. 1989), but gaps remain in our understanding of brucellosis in caribou. Measures of the prevalence in different herds, the mechanisms for and the rate of transmission are unknown as is the effect of brucellosis on individual animals and the role in predisposing them to predation. In muskoxen, the two cases of brucellosis are the only records for muskoxen after Gates et al. (1984) described a case near Baker Lake.

Brucellosis is important to the hunters from condemnation of

carcasses and lost hunting effort but also because of the significance of brucellosis for human health. Since 1986, 6 cases of human brucellosis have been reported in the Kitikmeot Region compared to 25 in the N.W.T. of which 15 were in the Baffin Region (D. Thompson pers. comm. 1991) where brucellosis in caribou is relatively common (M. Ferguson pers. comm. 1990).

The most prevalent pathogenic parasite was besnoitosis. The life-cycle of Besnoitia spp. in the Arctic is unknown, but a carnivore primary host is likely. Given the apparent prevalence of besnoitosis on southern Victoria Island where wolves are relatively rare, arctic foxes may be a suitable host. The roughness of Besnoitia cysts which is readily felt like "sand-paper" along the tendon fascia of the lower legs is familiar to hunters but often passes unmentioned. It is interesting, however, to recall the comment of Moses Putuguq during the survey of the traditional knowledge of brucellosis in Gjoa Haven (Appendix A): "And then there are some caribou with other sickness under the skin and the meat feels like sand, this type we were told to never eat even when cooked.".

Another common protozoan parasite is Sarcocystis which was found in 8 caribou from Victoria Island, Adelaide Peninsula and Spence Bay and muskoxen from Victoria Island. The structure of the cysts suggests that caribou may harbour two species of Sarcocystis. Sarcocystis has also been found in muskoxen on Banks Island (Tessaro et al. 1984). Sarcocystis is pathogenic in mule deer and cattle in the U.S.A., but its pathogenicity in elk is unknown

although high numbers of cysts result in carcasses being condemned for human consumption. The opportunistic finding of a few cysts in muscle from two polar bears and a large number of cysts in one arctic fox was surprising as Sarcocystis has a herbivore-carnivore life-cycle and the sexual reproductive phase is usually in carnivore intestines and the cysts are found in herbivore muscle. Muscle samples from only three polar bear and two fox samples were examined. The significance of Sarcocystis in arctic wildlife is unknown.

The dependence of NWT residents on wild meat accentuates the importance of understanding the endemic diseases and parasites. Zoonoses such as brucellosis are of obvious concern. Other parasites such as Taenia ovis krabbei and besnoitosis are important especially with increasing meat sales as high levels of infection of those parasites are unsightly in meat. Data for a quantitative comparison were not collected but complaints of caribou with unsightly numbers of tapeworm cysts in muscle were more common on the mainland than on southern Victoria Island. This likely reflects the lower number of wolves on Victoria Island as wolves are the final host. The measurements of the cystocerci do not precisely match those for Taenia ovis krabbei but are the closest to that species.

The other side to the importance of diseases and parasites is their role in population dynamics. Conventionally, their role has been downplayed compared to the more dramatic effects of predation, weather and range conditions. However, diseases and parasites

likely subtly interact with other factors and magnify or diminish their effects. For example, the protostrongylid nodules may increase the vulnerability of muskoxen to predation if large numbers of nodules impair breathing especially when an animal is chased.

The Protostrongylid lungworm found in a radio-collared muskox cow in 1988 then again in a radio-collared cow killed by a grizzly bear in 1989 is believed to be of the genus Protostrongylus (L. Polley pers. comm. 1990) but identification is still underway. The only published reference to the family Protostrongylidae in free-ranging muskoxen was to an unidentified species of Muellerius found as larvae in muskox faeces from Nunivak Island, Alaska. The formation of distinct nodules is unusual for Protostrongylus and is more characteristic of Muellerius. The larvae of those two genera are difficult to separate and those found in the muskoxen do not conform to descriptions of Muellerius capillaris, the only described species from this genus. Protostrongylus is a serious parasite in bighorn sheep as infections predispose the animals to outbreaks of pneumonia. Transplacental infection occurs in bighorn ewes and subsequently leads to lamb mortality mid-summer (Schwantje 1988).

Muskoxen presumably occupied the Rae-Richardson river valley before the 1960s but historic records (Barr 1989) are either vague or refer specifically to sites along the Coppermine River and Great Bear Lake. Understanding the history of the muskoxen could be useful in unravelling the significance of the lungworm which has

not been described before in muskoxen. Whether the muskoxen have colonised or recolonised the area may shed light on whether or not the parasite has been recently introduced to the muskoxen. Newly introduced parasites frequently evoke a strong immune response from the host that may be as damaging as or more damaging than the direct effect of the parasite itself.

The apparently greater number of lungworm cysts in muskox bulls may be related to their feeding in smaller wet sedge meadows along creeks and around lakes compared to the distribution of the large herds. In wet vegetation areas they may be more likely to ingest the snail secondary host of the lungworm. Muskox bulls also ingest more food than other sex-age classes which may also contribute to their higher levels of infestation assuming that within limits the levels of infection are directly related to exposure levels. A similar situation may occur in the vulnerability of adult males on Banks Island to the bacterial disease Yersiniosis (Blake et al. In Press). The level of infection in Yersiniosis is directly related to the amount of bacteria ingested with food.

Adult bull muskoxen may also be more frequently seen with traumatic injuries and infections as a consequence of horn injuries sustained during fighting. The only traumatic injuries we have described were all adult bulls, which supports the contention of Wilkinson and Shank (1976) that rutting aggression does cause injury and death. Their evidence was skimpy, being restricted to the necropsy of a young bull (severe contusions along shoulder and back), and 3 adult males and one adult female that were examined

but no autopsies were performed. One male had a gore wound in the flank and three had frank blood in the nostrils and anus which could be a terminal event of a number of different causes of death. Wilkinson and Shank (1976) extrapolated those 7 carcasses to a mortality of 5 - 10 % due to rutting injuries, but their descriptions do not preclude other causes of death. In the Thomsen Valley which was Wilkinson's and Shank's study area, acute deaths from Yersiniosis are common (B. McLean pers. comm. 1990).

A significant event in wildlife diseases in the Kitikmeot Region was the epidemic of Canine Distemper which probably started and was spread by arctic foxes. The magnitude of the invasion of arctic foxes in Cambridge Bay in September 1987 was an unprecedented event in Canadian arctic history (T.G. Smith pers. comm. 1988). Fox productivity was reported to be high, but heavy rain fell in August forcing lemmings to abandon their burrows. Thus, weaning pups had plentiful food and survival was high (D. Kaomayok pers. comm. 1987), but as freeze-up started the foxes were drawn to the community. The outpost camps on southwestern Victoria Island also reported high numbers of foxes at their camps in September and October 1987 (J. Atatahak pers. comm. 1987). The appearance of foxes preceded the outbreak of Canine Distemper Virus (CDV) in the Kitikmeot Region which appeared to start in Cambridge Bay but cases quickly followed in all communities suggesting that dispersing foxes were spreading the virus. By March 1988, CDV was widespread across the Canadian Arctic (Leighton et al. 1988) and reached Greenland in 1988. By March 1988, most surviving dogs in

the Kitikmeot Region had been vaccinated during an aggressive campaign based on the need to try to protect the dog teams as they are needed for polar bear non-resident guided hunts. The reservoir of unvaccinated dogs which encouraged the epidemic resulted from a change in the rabies vaccines provided to the R.C.M.P. who distribute the vaccine to dog-owners as a community service. Between 1979 and 1989, the vaccine was rabies-only whereas previously it had been a combined rabies-CDV vaccine. In 1989, the vaccine was changed back to a combined vaccine.

The importance of wildlife disease in population dynamics may be difficult to demonstrate for diseases or parasites more inconspicuous than rabies. Cause-and-effect relationships are confounded when higher levels of parasites are found in animals of poor condition as it is not clear as to what extent the parasites caused the poor condition or were able to escape the body's defence mechanisms when the animal was in poor condition. May (1983) suggested that the inter-play between parasitic infections and the host animal's nutritional status is significant in density-dependent regulation of populations. Most caribou and muskox populations in the NWT have increased or are still increasing in size during the 1980s and density-dependant mechanisms of population regulation may come into play. A severe winter or series of severe winters could compound the effects of any forage restrictions consequent to high densities and that combination of events to trigger these seemingly innocuous parasites into the onset of disease and mortality.

An example of the difficulty in describing the importance of parasitic effects on population dynamics comes from Banks Island. The example is important not just in understanding what is happening on Banks Island, but also as an indication of what may happen in other increasing muskox populations and what factors should be monitored. The increase in the prevalence of lungworm in muskoxen examined during the commercial harvests on Banks Island (Rowell 1989, McLean pers. comm. 1990) was paralleled by an increase in the only gastrointestinal parasite monitored (Ostertagia) - it is possible, but by no means certain that the increase in population densities of the muskoxen (McLean and Fraser 1989) played a role in the increase in the parasitism of the muskoxen. With the exception of the yearling muskoxen, no disease or mortality has been related to the increase in the parasitism. Muskox yearlings collected in 1989 in the area with the highest density of muskoxen on Banks Island were heavily infected with lungworm and were in poor physical condition (B. McLean pers. comm. 1990). The preceding winter, however, was characterised by heavier than average snowfall which may have caused or accentuated their poor condition (Gunn et al. 1991).

Another plausible explanation is that the high numbers of lungworm in yearling muskoxen is a normal phenomenon and had not been previously detected due to lack of sampling. The results of the collections on southeast Victoria Island suggest that this explanation is less likely as the yearlings had no heavier lungworm burdens than the other sex/age classes. In other ungulates such as

elk, however, lungworm disease is most frequent in yearlings and causes mortality (Kistner 1982) in populations that concentrate in high densities on their winter ranges. Kistner (1982) commented on the high levels of gastrointestinal parasites in the yearling elk with high counts of lungworms and concluded that their deaths could not be ascribed to either the lungworms or gastrointestinal parasites with any certainty.

Questions about the interaction of diseases and parasites with other environmental factors strongly indicates that we should routinely monitor the prevalence and infection levels. Commercial harvests offer opportunities to screen large numbers of animals routinely for certain parasites or diseases. The choice of which parasite or disease is partly a selection for ease of monitoring to avoid interference with the processing of carcasses and ease of counting or scoring the presence or absence or infection level.

Questions on the lifecycle or pathogenicity of some of the prevalent parasites remain which leaves us without a basis even to speculate on their role in the ecology and well-being of their hosts. There is, then, a need for basic research on parasites as well as routine screening during collections.

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PERSONAL COMMUNICATIONS

J. Atatahak	Coppermine
E. Broughton	Agriculture Canada, Ottawa
R. Dieterich	University of Alaska, Fairbanks
M. Ferguson	Renewable Resources, Pond Inlet
D. Kaomayok	Renewable Resources, Cambridge Bay
B. McLean	Renewable Resources, Inuvik
L. Polley	Western College of Veterinary Medicine, Saskatoon
T.G. Smith	Fisheries and Oceans, St. Anne de Belleview
D.L. Thompson	Environmental Health, NWT Health, Yellowknife

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APPENDIX A. Surveys of traditional knowledge of brucellosis in Pelly Bay, Spence Bay and Gjoa Haven, 1990.

Pelly Bay

1. Yvo Anguti
   26/05/39
   I have never heard of this disease brucellosis from my parents or from anybody when I was a young fellow. I have just recently started hearing and seeing about these swollen leg joints and testes on the caribou within the last five year.

2. Ginno Akkak
   01/08/28
   In the olden days when I was growing up once in a while someone would catch caribou which was sick and I use to see enlarged testes and some infection and puss on the meat and when one of these were caught they would cut off the infected area and use the meat for food that's how they were in the olden days. Today the caribou sickness is very common now due to the increase of the population.

3. Christian Nalungiaq
   12/03/40
   In the olden days I have never heard or seen any sick caribou with puss on the legs. I started learning about the sick caribou when the whiteman started coming. The caribou sickness appeared to happen when the population grew within the last ten to fifteen years ago.

4. Jose Angutingungniq
   00/06/25
   I have never heard of any swollen leg joints and enlarged testes on a caribou when I was younger. When the whiteman came they left garbage and waste and I think that's why the caribou got sick from it in those days caribou only had old broken bones which happen from falling off rocks but recently like within the last ten years or so I started noticing sick caribou.

5. Dominique Intuinaq
   27/07/34
   I have never heard of any swollen leg joints in my days I only started noticing the swollen leg joints and testes recently. I think that this started when whiteman started leaving garbage on the land, it never use to be like that before but has started within the last three years ago or so.

6. Simon Inuksaq
   31/03/23
   I have never heard my parents or the older people talk about sick or the diseased caribou such as swollen joints or enlarged testes. I only started learning about this disease around the year 1979 and the first abnormal caribou I saw during that year was the

little white spots in the caribou meat and then afterwards later on in the year I started seeing caribou with swollen legs joints. When I was a young boy there were a lot of caribou then the caribou population started declining in those days then the caribou population grew back with the disease brucellosis.

7. Solomon Iqquguituq
07/01/46
I have never heard of any disease caribou then I was a young boy. The only abnormal caribou in those days were the caribou with old broken legs that have healed. I only started learning about the caribou with swollen leg joints and enlarged testes more than ten years ago.

8. Timothy Kayarsark
01/01/15
I have never heard my parents or from the older people about the swollen leg joints or enlarged testes. I only seen a large like overgrown wart like lump on a caribou once and old broken bone that have healed. I only started hearing about the diseased caribou when the whiteman started coming when they started leaving garbage on the land and when the caribou population grew in a big number.

9. Patrick Qagutaq
01/01/15
I have never seen or heard of swollen leg joints or enlarged testes from my parents or the elders in my time. The only abnormal caribou in those days were caribou with broken legs that have healed and they say they probably broke them in the rocky area. I only started learning about the disease on the caribou just recently after the population grew in a big number.

10. Otto Apsaktuan
01/07/32
I have never heard or seen this disease called brucellosis from my parents or the older people in my young days. I just recently started finding out about the diseased caribou like within the last ten years or so when the caribou population grew. The only abnormal caribou I heard of were the ones with old broken legs or wounds.

11. Emiliano Kringorn
21/11/50
I have never heard of this disease called brucellosis from my parents or the older people when I was young. It was in the recent years around 1982-83 that I first saw swollen testes on a large male caribou and it was around that time that I started hearing about swollen leg joints from the other hunters.

Spence Bay

1. Tommy Ashevak
   01/01/1931
   I have never seen or known of any diseased caribou in my time. I have only started noticing the skinny diseased caribou within the last ten years or so.I have never heard my father talk of any diseased caribou as I was growing up.

2. Stephen Alookee
   01/07/1937
   When I was a young boy my parents and other hunters use to hunt caribou at Thom Bay and Fort Ross area but I have never heard of this disease then. I had never heard of this disease in those days. I only started hearing and noticing this disease recently, only within the last four years when the caribou migrated back from the south of Spence Bay. When the caribou herd started growing near Spence Bay the disease was not known then it only seem to show up when the caribou started to migrate back north from the south of Spence Bay.

3. John Takolik
   01/01/1909
   I have never heard of such disease as I was growing up, I have never heard of my parents talk about this disease. Just recently I started to hear of this disease, just within the last three years.

4. David Kingatook sr.
   01/01/1920
   I have never seen or heard of this disease in the past, I have only started to hear of it recently. My father once told me that caribou will eat anything, even other dead animals, also they would chew on antlers that had been dropped.

5. Jacob Jayko
   01/01/1932
   I have never heard of this disease in the past, but only recently within the last two years, my parents have never mentioned this disease, nor have the older people ever mentioned that this disease existed.

6. Joseph Kiloonik
   15/11/1938
   I have never heard of any diseases of this kind, only of old wounds that have gone bad on a caribou when I was younger. I only started learning about this disease within the last three summers. I also seen a dead caribou which was very skinny, probably died due to starvation, this happened not to long ago.

7. Samuel Nashariatook
01/01/1923
This disease has only started to show up not to long ago , I only started noticing this disease within the last two years . When I was younger I hunted many caribou but I have never seen this disease on any caribou, also I have never heard my parents talk about this disease.

8. Adam Totalik
01/01/1924
I have never known or heard of brucellosis when I was growing up. There were hardly any caribou then, I only started noticing and hearing about this disease within the last three or four years, and never before that time.

9. Jimmy Totalik
01/01/1931
I have never known or heard of any diseases like brucellosis. There were hardly any caribou around here when I was young man. I only started hearing about this within the last ten years. I have never heard my father talk about any diseases on caribou.

10. David Tucktoo
01/09/1934
I have heard that many, many years ago that caribou use to have the disease brucellosis and that it killed some people after eating the meat. But it has been only recently, within the last three years that I first sent out a sample with this disease.

GJOA HAVEN

1. Moses Tookomie 35

1. Did you ever see a caribou with brucellosis ? Yes.
2. Was it long ago or recently ? Last summer.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? They never used to see this in the old days.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? It's brand new stuff to me.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? I seen caribou with white pus along the hinges of the leg and inside the sinuses.
6. Do you remember any stories of the old days about being on the land that people should know about ? My grandparents used to hunt only caribou and fish and really had no problem with the meats back then.

2. Andrew Oogak 58

1. Did you ever see a caribou with brucellosis ? Yes.
2. Was it long ago or recently ? Two years ago and this year.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? No.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Yes a recent problem.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Two years ago when my son caught a sick caribou.
6. Do you remember any stories of the old days about being on the land that people should know about ? Not much about caribou.

3. Mark Kununak 58

1. Did you ever see a caribou with brucellosis ? Yes a few times.
2. Was it long ago or recently ? Last year and three years ago.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? Most of the caribou used to be in good shape not like today.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Only once in a long while many years ago we see something like that. Nowadays caribou have all kinds of problems just like people.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? More than five in the last three years.
6. Do you remember any stories of the old days about being on the land that people should know about ? If you see an animal that is abnormal you should not eat it.

4. Nick Qayutinuaq 70

1. Did you ever see a caribou with brucellosis ? I am not sure of that but I am seeing lots of caribou now with yellow and clear fluid in the joints.
2. Was it long ago or recently ? Just the last few years.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? It has been so long that I do not remember of any diseases in animals.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Just a few years ago it started.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Not long ago maybe five years or so.
6. Do you remember any stories of the old days about being on the land that people should know about ? Any animal that does not look right should never be eaten.

5. Philip Nimiqtaqtuq 61

1. Did you ever see a caribou with brucellosis ? Some times I send one piece of caribou meat out and the leg on May 23, 1987.
2. Was it long ago or recently ? I don't remember about brucellosis a long time ago but long ago I seen some caribou with very long hoofs but only in winter.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? Long ago they didn't talk about these things but the ones with long hoofs the meat was eaten.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? I don't remember. Recently, I think I had not seen this in the old days, sometimes some of the caribou have fluid in the joints but not large ones.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? As above.
6. Do you remember any stories of the old days about being on the land that people should know about ? The young people should know that the abnormal caribou should not be eaten and reported to the wildlife officer.

6. Moses Putuguq 68

1. Did you ever see a caribou with brucellosis ? I have many times.
2. Was it long ago or recently ? Not so much, mostly now.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? Every living being get sick and grow old then things all die. Long ago we came across some dead animals and even caribou, my parents did too.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Yes and no but mostly now.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Long time ago but more often now.
6. Do you remember any stories of the old days about being on the land that people should know about ? You can cook the meat of caribou with brucellosis and eat it not a dead caribou that you found. But you should never feed it to dogs, even the good part of the meat. And then there are some caribou with other sickness under the skin and the meat feels like sand , this type we were told to never eat even when cooked. Sometimes there are other sickness anything we are not sure of we should not eat.

7. Alice Konana 58

1. Did you ever see a caribou with brucellosis ? Yes.
2. Was it long ago or recently ? Starting just a few years ago.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? No, nothing like that.

4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Just recently.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Three years ago.
6. Do you remember any stories of the old days about being on the land that people should know about ? When I was a young child I never heard anything about that.

8. Luke Nuliayuk 59

1. Did you ever see a caribou with brucellosis ? Yes at Kuptak (Elliot Bay) this caribou had abscesses at its foreleg, there was even a sore of living worms in it (white).
2. Was it long ago or recently ? Recently, forgot the year.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? I had never heard of brucellosis in the old days.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Brucellosis was never known to me in my younger days
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Only the one I just talked about.
6. Do you remember any stories of the old days about being on the land that people should know about ?
The young people who just starting to hunt by themselves should not eat the meat of any game that are not normal.

9. Peter Ookpik 49

1. Did you ever see a caribou with brucellosis ? Starting four years ago I had seen caribou with this problem.
2. Was it long ago or recently ? Since four years ago.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? When I was young I had never seen or heard of these diseases in caribou.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? This is a recent problem there are more of them each year.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? One caribou had the lungs full of clear fluid, another had fluid in the meat, another had fluid in the joints and abnormal hoofs these caribou it seems to have started these problems from the east near Spence Bay.
6. Do you remember any stories of the old days about being on the land that people should know about ? If the caribou is abnormal it should not be eaten, I had seen one female with not much hair under the belly I do not usually skin them as they are no good to eat. I fed them to dogs and they did not get sick this was before the recent problems with caribou.

10. Ben Porter 51

1. Did you ever see a caribou with brucellosis ? Started to see them
around 1980s.
2. Was it long ago or recently ? Early 1980's to present.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? None of us seems to ever hear anything about this disease in caribou. One had large testes last spring.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Just recently we started hearing and seeing them.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Some have yellowish fluid in the joints thick and may be alive in the young.
6. Do you remember any stories of the old days about being on the land that people should know about ? One of my sons got tapeworm from a caribou and had to go out to the hospital to have them removed. The worm was in his blood, the doctor says it was from caribou.

11. Hugh Avattaq

1. Did you ever see a caribou with brucellosis ? Yes, last year or more than one year ago.
2. Was it long ago or recently ? Same time around June of this year 1990 starting last two years.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? I don't remember I may have forgotten.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? I just recently started to see them.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? I just started to see them near Baker Lake last year in 1989.
6. Do you remember any stories of the old days about being on the land that people should know about ? No

12. David Siksik 62

1. Did you ever see a caribou with brucellosis ? I am starting to see them.
2. Was it long ago or recently ? When I was young they were not like that.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? Long time ago I don't hear anyone talking about the diseases, but I shot one many years ago a bull that was blind and sick.

4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? I know it is a recent problem and last year I caught one with very large testes the inner thigh had no fur.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? I caught one this spring with very long hooves then this fall I saw one with very bad joints and when I cut the legs worm like things came out.
6. Do you remember any stories of the old days about being on the land that people should know about ? I know that young hunters should be made aware of these diseases.

13. Gideon Qitsualik 59

1. Did you ever see a caribou with brucellosis ? I have seen one myself some with long hooves and pus in the joints.
2. Was it long ago or recently ? I heard of people talking about this only recently.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? No one used to talk about diseased caribou.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? Just last spring around June of this year I seen a lot of dead caribou near camp three (DEWline)
5. When was the first time you might have seen something in a caribou similar to brucellosis ? Only the above mentioned ones.
6. Do you remember any stories of the old days about being on the land that people should know about ? I heard when I was young that if the meat doesn't go bad after a few days it is good for eating if the animal is not very fat it just did not have enough to eat.

14. Dominic Tungelik 62

1. Did you ever see a caribou with brucellosis ? Once in a long while I seen a little few years back (4 to 5 yrs).
2. Was it long ago or recently ? Yes. Yes many years ago there were lots of caribou than about 20 years ago.
3. Did you ever hear stories from your parents about diseases in caribou similar to brucellosis ? Ever since I was a child I haven't seen or hear anything like that. I had heard that the caribou can eat anything.
4. Do you feel that brucellosis is a recent problem or something that has always been in caribou ? I just started to see them in just a few years ago.
5. When was the first time you might have seen something in a caribou similar to brucellosis ? When I came to Gjoa Haven just about five years ago from Repulse Bay.
6. Do you remember any stories of the old days about being on the land that people should know about ? If a caribou is not

normal you should not eat it and take a portion of it to the wildlife officer.

APPENDIX B. Chronology of events surrounding canine distemper in the Kitikmeot Region, October 1987 - February 1988

1987

September - October

Cambridge Bay was invaded by hundreds of foxes and many interactions between dogs and foxes were reported. No sick foxes were described though injured foxes were relatively common.

21 October

Cambridge Bay Owner reported pup to have been depressed, no appetite, laboured breathing: owner was concerned about rabies so dog was shot and tested negative rabies.

10 November

Cambridge Bay - sick dog acting strangely so shot but tested negative for rabies.

13 November

Cambridge Bay - several dogs reported to be sick - description of symptoms vague but refer to loss of appetite, some had diarrhoea and at least one dog had infected eyes with pus. Discussions with Dr.s Broughton and Leighton (Agriculture Canada and Western School of Veterinary Medicine, respectfully) suggest possibly either parvovirus or canine distemper. Spread of the disease was considered likely so to protect the dog teams for polar bear guided hunting, vaccines and are requested from Broughton.

2 December

Cambridge Bay - 18 known dog deaths
Holman - 2 dogs died

8 December

WCVM diagnoses (preliminary) distemper

8 December

Pelly Bay - one dog reported sick and shot

11 December

Holman - 3 more dogs died

18 December

Cambridge Bay - 31 dogs known to have died
Holman - 38 dogs known to have died
Pelly Bay - dog next to previous sick dog developed same symptoms and shot

22 December

Sachs Harbour - reports of dogs dying

28 December

Coppermine - Jack Atatahak (arrived from outpost camp Read Island, southwest Victoria Island) one dog dead at camp and 1 pup died at Coppermine.

29 December

Gjoa Haven - 4 dogs died previous week.

29 December

Holman - 6 dogs died over Christmas

1988

4 January

Send vaccines to all communities.

February/88 Summary

Community	No. dogs vaccinated	No. dogs died	No. Work teams-	Comments
Spence	76	01	02	Sport hunt cancelled for 88.
Pelly	128	09	08	Sport hunt cancelled for 88.
Cambridge	49	38	02	Vaccinations continuing
Bay Chimo/Bathurst	Vaccine sent in for 45 dogs, other info. not available.			
Gjoa	89	12	8-9	23 dogs still to be done
Coppermine	87	22	02	dogs still dying
Holman	All?	46	11	confusion over status as Vet's records not available.
Totals	589	128(22%)	+/- 33	

APPENDIX C. Gross and Histological Pathology of Muskoxen, collected from Surrey Lake, Victoria Island, NWT (S.V. Tessaro April, 1985).

At necropsy, the adult and yearling muskoxen lacked subcutaneous fat stores but did have small amounts of epicardial, perirenal, omental, and mesenteric fat. None of the animals had serious atrophy. Each muskox had very coarse feed, mostly willow stems and roots, in the rumen. The cows with calves were still lactating and the calves were in good body condition. None of the adult females were pregnant.

Macroscopic lesions were seen in two muskoxen. The 6+ year old bull (specimen #8) had a 1-2 cm diameter penetrating wound through the skin and abdominal musculature behind the last rib on the left side. The tract continued through the ventral sac of the rumen and through the reticulum. There was haemorrhage in the musculature of the right abdominal wall adjacent to the exit hole in the reticulum. There was a small amount of fibrin and gut contents in the omental sling and the rest of the abdominal cavity. The lesion appeared to be a bullet wound although a bullet was not found. The small amount of fibrin and peritoneal reaction indicated that the wound had occurred within a few hours of death and the large amount of subcutaneous edema and already clotted blood indicated that the wound had happened prior to the hunter's killing shot.

One female yearling (specimen #10) had hydronephris of the right kidney. The renal pelvis was approximately twice normal volume and the right ureter was dilated from the renal pelvis to a point 3 cm from the bladder at which the luminal diameter was greatly reduced by fibrous connective tissue in the wall of the ureter. The cause of the lesion was not evident. The left kidney was normal.

A 2 cm long nematode was found in the lumen of a major bronchus in the caudal lobe of the right lung of another female yearling (specimen #16). This parasite was submitted to the Western College of Veterinary Medicine for identification. The lungs of this muskox were grossly and histologically normal and no other nematodes were seen.

Formalin fixed samples of lung, liver, kidney, spleen, heart, abomasum and adrenal glands were routinely collected from each muskox and other tissues were taken if warranted on gross inspection. All of these samples were examined histologically.

Specimen #1, a 3 + year old cow, had a notable chronic interstitial pneumonia. Some of the large bronchioles were plugged and partly to completely obliterated by large aggregations of lymphocytes, macrophages and fibroblasts which had granular, eosinophilic debris located centrally. In some of these lesions there were numerous eosinophils and a few giant cell immediately around the debris. There was very extensive smooth muscle hyperplasia throughout the lung. There were also a few large lymphocyte aggregates present and some alveoli contained edema fluid. The alveolar septa were diffusely thickened by infiltration of lymphocytes, macrophages and fibroblasts. The macrophages

frequently contained brown granular pigment. The etiologic agent(s) was not evident but the appearance of the lesion suggested a chronic, immune-mediated reaction. Microbiology results may provide more information on the cause of this pneumonia. It was noted that this animal had been in the poorest condition at the time of slaughter.

Three other muskoxen (specimens #3, 21, and 23) had mild to moderate thickening of the alveolar septa due to mononuclear cell infiltration. Lung lesions had previously been seen in Banks Island, NWT, muskoxen but the predominant lesion was a subacute to acute bronchiolitis suggestive of viral infection. This was not seen in the Merkeley Lake animals. Further bacteriology and virology research is needed to determine the cause(s) of pneumonia in muskoxen.

Sarcocysts were seen in the myocardium of one yearling (specimen #4) and eight adults (specimens #1, 3, 5, 11, 21, 23, 25, 26). There was no tissue reaction around these parasites. Given the presence of low numbers of Sarcocysts in these animals, it is likely that other of the muskoxen in the sample were infected even though cysts were not seen in the single myocardial sections examined.

Cross-sections of adult nematodes were seen mixed in with the ingesta on the mucosal surface of the abomasums of four yearling (specimens #12, 14, 18, 19) and six adults (specimens #1, 8, 21, 23, 24, 26). The parasites did not occur in the crypts or within host tissues, and there were no lesions associated with the presence of the nematodes. Dr. G. Wobeser (pers. comm.) recently found Ostertagia-like lesions in the abomasums of some Banks Island muskoxen. More than one species of nematode may occur in the abomasums of NWT muskoxen.

In summary, gross and histological examination of the 27 muskoxen indicated that the adults and yearling were very lean but not yet in the late stages of starvation. Calves were in good condition. The parasites observed in the muskoxen included Sarcocystis sp., an intraliminal abomasal nematode, and an intra-bronchiolar nematode. No remarkable disease lesions were found with the exception of one case of chronic interstitial pneumonia of undetermined etiology.

If these muskoxen had not been killed and had remained on the island for several more weeks until freeze-up permitted them to escape, it is unlikely that they would have been in adequate body condition to survive the winter. This opinion is based on the very lean condition of the animals at the time of death (especially when compared to healthy muskoxen on Banks Island) and on the assumption that muskoxen must develop adequate fat reserves prior to winter as do most other arctic and temperate climate ungulates. Future studies on the seasonal energetics of free-ranging muskoxen will provide greater insight into the biology and management of this species.